

REPORT 1217

FUTURE DEVELOPMENT OF HDTV

(Question 27/11)

(1990)

1. Introduction

The Extraordinary Meeting of Study Group 11, May 1989, identified studies that need to be undertaken as expeditiously as possible in order to further build on the agreements already achieved. This report outlines:

- approaches to a single world-wide HDTV studio standard;
- preliminary studies;
- further activities to be undertaken.

2. Approaches to a single world-wide HDTV studio standard2.1 Concepts for approaches to a single world-wide digital HDTV studio standard

The long-term future of HDTV lies in the digital domain, and equally the long-term future of HDTV standards should lie with unique world-wide standards. In order to achieve this, a number of alternative routes were identified at the 1987 CCIR Interim Meeting. They were essentially defined in digital terms, with any required analogue definitions derived from the digital ones. The routes proposed were as follows:

a) The concept of a "virtual studio standard"

In this concept, there is a unique format for a digital data bus which is used to transport and record HDTV signals. The source and destination could communicate using the unified standard by means of gateways, which perform the appropriate standards conversion.

A "virtual studio standard" [Miceli, 1986; Fierro and Miceli, 1987], may be considered as a common standard for the purpose of exchanging programmes. Consequently, its characteristics should be chosen in order to allow the minimum of artifacts resulting from possible double conversions.

Some general characteristics of the virtual studio standard would include:

- a) it should be digital, because of the greater flexibility and the most powerful processing capability allowed;
- b) it should be independent of the physical studio equipment and therefore from the current technology;
- c) it should allow enough headroom for production, the standards conversion process and for accommodating future needs;
- d) it should lead to manageable bit rates.

The overall system performance between source and destination at any time, will be dependent on the characteristics of the actual equipment in the video chain at that time. Therefore, the system performance can be further improved, without affecting the coding structure, by simply improving the local characteristics of the weakest devices along the video path.

Examples of this concept are found in discussions of the common image format and common data rate approaches below.

- b) The concept of a totally unique parameter set from the outset (adoption of an existing proposal in digital form)

In this scenario there would be, from the outset, a direct and universal adoption of a single studio standard. This could arguably be based on 50 Hz, 60 Hz, or even some other value. Factors which could affect the choice include motion portrayal, existing practices and display technology.

Examples of possible values can be found in Part 5 of Report 801.

- c) The concept of a two-step approach

This scenario relies on the widespread introduction of switchable (50 Hz-based/60 Hz-based) HDTV studio equipment. This would not dispense with the need for standards conversion in HDTV programme exchange between countries using different standards, but it would lead to the possibility of the universal use of one or other systems in the course of time.

- d) The concept of a convergent approach

This scenario relies on the adoption of common spatial characteristics of the active picture area for applications using current picture rates initially with ultimate convergence on a single picture rate in the course of time.

2.2 Possible approaches to the development of a single world-wide HDTV standard

This section examines some approaches to a unified world-wide HDTV standard from the viewpoint of digital technology and outlines approaches that could be considered as routes towards a single world-wide standard.

[CCIR, 1986-90a] from IWP 11/7 also discussed related studies for digital formats. Three approaches to achieve ultimately a "unique world-wide standard" for studio production and international programme exchange on the basis of the single picture rate are:

- the adoption of a single "unique" standard meeting the goals of Decision 58;
- the adoption of standards based on the "common image format" approach leading to the future adoption of a single standard;
- the adoption of standards based on the "common data rate" approach leading to the future adoption of a single standard.

Contributions have been received from a number of administrations further developing these concepts and the following explanations have been proposed to characterize and to distinguish between the "common image format" and "common data rate" concepts:

Common Image Format

The common image format (CIF) concept implies a commonality of spatial characteristics for the active picture area between implementations or applications with differing picture rates. These common characteristics include the picture aspect ratio, the number of samples per active line and the number of active lines, as exemplified in current proposals for HDTV. Other system characteristics may also be common whilst sampling frequency and data-rate may vary according to the picture rate.

Common Data-Rate

The common data-rate (CDR) concept implies a commonality of sampling frequency and data-rate (total and active) between implementations with differing picture rates. The picture aspect ratio and the number of samples per active line are also common, as exemplified in current proposals for HDTV. Other system characteristics may also be common whilst the number of active lines may vary according to the picture rate.

Proposals have also been made combining the features of a common image format approach with a common total data-rate.

Also the following definitions [CCIR, 1986-90b] are intended only for use in clarifying CCIR texts concerning HDTV.

A Sample is the value of an image at a defined point in horizontal, vertical and temporal space.

A square sample distribution results when the sampling points are equispaced on an orthogonal horizontal-vertical lattice on a time-discrete image plane, assumed to be vertical for the purpose of this definition.

Pixel is the abbreviation of "picture element". It is the smallest area of the optical image that can be faithfully reproduced.

A square pixel has equal size in the horizontal and vertical directions.

With respect to the resolution actually achievable, the relation between samples and pixels is not necessarily identical in either or both the horizontal and vertical directions

2.2.1 A unique standard

All administrations have stated their preference for a single world-wide studio standard for HDTV. In [CCIR, 1986-90c] are summarized the essential reasons for the need for a world-wide unique studio standard for high definition television.

In [CCIR, 1986-90d] EBU states that it remains convinced of the value of a totally unique standard, but is studying other approaches against the possibility that it cannot be achieved.

Based on analysis [CCIR, 1986-90e] and the information contained in Part 5 of Report 801-3 the United States concluded that a single world standard should be based on 1125/60 [CCIR, 1986-90f]. The United States now believes [CCIR, 1986-90g] that it is apparent that unanimous agreement on a complete set of parameter values for a single world-wide HDTV studio standard is not possible during the 1986-1990 study period. Therefore, the United States proposed that the adoption of a single world-wide HDTV studio standard be extended to the 1990-1994 study period.

In Document [CCIR, 1986-90h] the United States reaffirms its support for the adoption of a single world-wide HDTV standard for the studio and for international programme exchange as a very important CCIR goal.

A proposed draft Recommendation supported by 11 administrations for parameter values for a single world-wide programme standard (1250/50/1:1) is given in [CCIR, 1986-90i].

Document [CCIR, 1986-90j] states that these European Administrations report that the administrations of the European Community fully supports the goal of a unique studio standard and considers that the 1250/50/1:1 system best meets this target. However, following agreement within the CCIR to study a two-step approach based on either a common image format or a common data rate, studies have been carried out into the relative merits of the two approaches and the results are analysed in the document.

Documents [CCIR, 1986-90k and l] argue that an HDTV standard that meets the needs expressed in CCIR documentation can most efficiently be implemented in the long-term with an image format of 1920 samples per line by 1080 active lines and a common frame rate.

2.2.2 A common image format approach

This approach, described by some administrations as a "unified" approach to a single standard is based on the fact that the development of a single standard is presently constrained by the desire for compatibility with the frame rates of existing television systems but that such constraint will likely be removed, in time, by developments in technology leading to the setting of a standard based on a higher frame rate for better motion rendition and easier conversion to all current frame rates. Initial studies [CCIR, 1986-90m] have indicated that frame rates higher than the ones presently in use will be needed in HDTV production if unimpaired motion portrayal is required. The common image format approach leads, in the interim, to a partial standard including only parameters for which single values are adopted on a world-wide basis. Adoption of common values for the basic parameters should lead to convergence towards a single world standard and avoid re-opening discussion on already agreed parameters during the later steps of the process. The partial standard

will allow different system implementations meeting the common agreed parameters and harmonized with the current television systems. The larger the number of parameters adopted at the beginning, the better it is to maximize homogeneity between the different system implementations, and the easier it will be to convert programmes produced through interim system implementations to the ultimate single standard.

In order to secure the convergence process toward a single standard, a number of basic parameters need to be identified for which single values have to be agreed upon early in the process. The multi-step "unified" approach is based on the concept of "common image format" to define the first step by allowing early agreement on image parameters leaving the frame rate, the scanning method and the related parameters for later discussions and agreement.

The concept of the Common Image Format is based on a broad view of image reproduction techniques including aspects from the fields of television, film, computer display and publishing. It consists of using common values for the parameters defining the active picture area in different HDTV system implementations. An image is a bounded, two-dimensional representation of a three-dimensional space which is defined by its spatial characteristics and its luminance and colour transfer functions. The image format is the specification of a virtual image defining the active picture area of the television frame. Figure 1 gives a pictorial representation of the concept of a common image format along with a possible set of parameter values.

The concept of a common image format applied in the context of the "unified" approach to a single HDTV standard implies a world-wide agreement on the following basic parameters of the active image area:

- aspect ratio of the image;
- aspect ratio of the picture element (pixel);
- number of samples in the horizontal direction;
- number of samples in the vertical direction (i.e. number of lines);
- sample arrangement;
- colorimetry - reference primaries, reference white;
- opto-electronic transfer characteristic at the camera; and
- electro-optic transfer characteristic at the display.

These correspond to the parameters in sections 1, 2 and 4 of the table in ——— Recommendation 709. ——— The definition of the common image format is exclusively confined to the samples and spatial domains of the active picture area and relates to its digital representation. The way this image is scanned for transmission, its repetition rate to reproduce motion, and its rendering on a physical display include temporal and subjective aspects that are beyond the definition of the image format. The concept leaves complete freedom as to the choice of scanning method, the frame rate and the size of the blanking intervals needed for synchronization and other purposes in the implementation of different HDTV distribution systems formats (see Fig.2) [CCIR, 1986-90].